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TRANSIT AND RIPENING STUDIES

with

CALIFORNIA MATURE-GREEN TOMATOES,

FALL 1953

by

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TRANSIT AND RIPENING STUDIES WITH

CALIFORNIA MATURE-GREEN TOMATOES, FALL 1953

SUMMARY AND CONCLUSIONS

The 1953 tests confirm the harmful effect of low temperatures on the subsequent ripening of mature-green tomatoes observed previously. Prolonged exposure to low temperatures in the field or during the transit period results in poor ripening and in decay.

Although low field temperatures during the last three shipping seasons reduced the prepackaging quality and ripening ability of the tomatoes as the season advanced, this adverse effect was minimized by avoiding over-refrigeration in transit. Excessive refrigeration of early-season shipments resulted in more total chilling injury than did moderate refrigeration of cars shipped later.

The increased pack-out of marketable tomatoes and the shorter, more economical ripening time obtained when temperatures in transit were moderately high, indicate a definite advantage from temperatures above 50° F. during the early part of the shipping season and above 55° later. Average temperatures as high as 68° for a 10-day transit period were not detrimental in these tests. It is concluded that temperatures from 55° to 65° are optimum for transcontinental rail shipment. Ripening occurs at these temperatures and, when evident on arrival, it indicates that serious chilling did not occur in transit.

The refrigeration records obtained confirm the observations made in 1952 that intermediate transit temperatures desirable for tomatoes can be obtained in modern refrigerator cars, shipped with vents closed, by limiting the amount of refrigeration to the actual cooling requirement of the load. Closing the vents of the cars prevented wasteful meltage of ice, protected the fruit from extreme outside temperatures, and made possible an estimation of the quantity of ice needed to cool each load to the desired temperature. The icing schedule shown on page 2 which was derived from calculations of the refrigeration required, provided adequate cooling for tomatoes with little danger of chilling injury. Comparative tests, made in 1952, of the need of ventilation for tomatoes in transit show no adverse effect on the fruits from shipping the cars with vents closed.

During both the 1952 and the 1953 season, the transit temperatures in the test cars shipped with vents closed and initially iced according to the experimental schedule indicate that the initial ice is adequate for a transit period of 6 days or slightly longer during the early part of the season and is effective for 9 to 11 days during cool or cold weather. The temperature records also indicate that during warm weather a light re-icing of long-distance shipments may be desirable to arrest temperature rise in the load after the initial ice is melted. One re-icing with 1/2 to 1 ton in each bunker provided adequate refrigeration in all instances, and the temperature charts indicate that the re-icing would probably be most effective if delayed until the fifth or sixth day in transit.

Temperatures of tomatoes in the middle-quarter position of the fan cars in these tests were found in several cases to be higher than those of the top-doorway position. The relatively wide difference between the middle-quarter and the bottom-bunker temperatures is probably due to the limited refrigeration supplied these cars. However, there is no indication that the middle-quarter temperatures were undesirably high for the tomatoes in the tests.

There is indication that placing the ice on half-stage racks instead of on the bottom racks results in more desirable bottom-bunker temperatures in transit.

Arrival records of several hundred commercial cars of tomatoes from the Tracy district, shipped with vents closed to distant markets and iced in approximate accordance with the experimental schedule, show that adequate protection was provided in transit. It is recommended that this schedule be used as a guide to obtain desirable transit temperatures for tomatoes.

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INTRODUCTION

Study of transit and field temperatures encountered by fall-grown tomatoes and their influence on ripening behavior was continued during the fall of 1953. Results of earlier studies 1/ 2/ indicate the harmful role played by chilling temperatures in the field and after harvest. Conclusions from the previous work are restated as follows:

(a) Low transit temperatures (below 50° F.) cause slow ripening and increase decay.

(b) The effect of chilling in transit increases as the season progresses, probably because of exposure to low temperature in the field.

(c) Undesirably low transit temperatures caused by over-refrigeration are not uncommon in commercial practice.

(d) Tomatoes can be shipped in cars with ventilators closed from origin to destination without harm despite a fear to the contrary of many shippers.

(e) Desirable transit temperatures can be maintained in closed tomato cars by limiting the ice supply to the actual cooling requirements of the load. A schedule of initial icing based on pulp temperatures at time of loading seems to have commercial possibilities.

OBJECTIVES

The objectives of the work carried out during the fall of 1953 follow:

(a) To follow throughout the season the temperature history of cars initially iced according to a schedule based on the loading temperature of the tomatoes.

(b) To determine the need for a light re-icing of the cars in transit.

1/ Barger, W. R., Friedman, B. A., Radspinner, W. A., and Morris, L. L. Shipping Tests with California Mature-Green Tomatoes, Fall 1951. U. S. Dept. Agr., BPISAE, H.T. & S. Office Report No. 286. 1952. (Also Univ. of Calif., Vegetable Crops Series: No. 57.)

2/ _____, Radspinner, W. A., Friedman, B. A., and Morris, L. L. Transit and Ripening Studies with California Mature-Green Tomatoes, Fall 1952. U. S. Dept. Agr., BPISAE, H.T. & S. Office Report No. 302. 1953. (Also Univ. of Calif., Vegetable Crops Series: No. 58.)

(c) To determine the effect of the resulting transit temperatures on ripening of the tomatoes during transit and on the subsequent pack-out of marketable fruit.

(d) To measure field temperatures throughout the fall and determine the relation between date of harvest, simulated transit temperatures, and subsequent ripening of the fruit.

PROCEDURE

Initial Icing Schedule

Temperatures obtained in transit in the 1952 tests, show that the calculated ice requirement to cool the load to an average temperature of 55° F. during the first 3 days is sufficiently accurate to serve as a basis for the initial icing of tomato cars shipped with all ventilators closed.

For the 1953 tests, the following schedule, adapted from the calculated values, was used to simplify the estimation of the desirable quantity of initial ice:

Average fruit temperature (°F.) when loaded	Initial ice per bunker
Between 80° and 90°	Full-bunker capacity (approx. 2 3/4 tons)
Between 75° and 80°	2 tons
Between 65° and 75°	Half-stage capacity (approx. 1 1/2 tons)
Between 60° and 65°	1 ton
Between 55° and 60°	1/2 ton
Between 50° and 55°	None

Shipping Tests

The general outline of the tests was similar to that followed in preceding years, in which carloads of Pearson tomatoes were shipped from the Tracy district of California to the New York market (Table 1). Paired-car tests with different protective services and single-car shipments were made to determine the effect of the transit temperatures resulting from the icing service on the stage of ripeness of the fruit at the market.

The cars were routed through Salt Lake City to Jersey City. Most of them were equipped with air-circulating fans and half-stage icing racks. All were initially iced at the shipping point and forwarded with all ventilators closed to destination. In most instances the cars were initially iced according to the test schedule shown above.

When two test shipments were made on the same day, the cars were loaded at the same packing house and shipped in the same train.

Initial fruit temperatures were obtained at intervals during loading of the cars. Transit temperatures were obtained with small recording thermometers placed in packed boxes of fruit and set in the top layer of the load near the doorway, in the middle layer of the quarter-length stack, and in the bottom layer near the ice bunker. These positions are referred to as top-doorway, middle-quarter, and bottom-bunker. A similar instrument was attached under the car to obtain outside temperatures.

Test boxes containing tomatoes of the same size and from the same field lot were shipped in each car for inspection and ripening at the market. They consisted of two-box lots placed at each of the thermometer positions in the load.

Information concerning the ripening of the fruits in the commercial loads at the market was obtained in 6 of the test cars by inspecting 25 boxes from the top-doorway position of the load and 25 boxes from the bottom-bunker position during ripening at a prepackaging plant.

Holding Tests

For the holding tests in California, five packed boxes of 6x6 size tomatoes were obtained at weekly intervals from September 23 to November 16 from fields near Tracy and Carbona. These boxes were held at Davis at constant temperatures of 41°, 50°, 55°, 62°, and 68° F. for 10 days to simulate a transit period to eastern markets. They were then inspected for ripeness and placed at 68° for further ripening. As the fruits attained table ripeness, they were individually classified as to good, fair, poor, or cull quality and removed from the sample. Fruits classified as good would be readily acceptable to the retail buyer; fair fruits would be marketable; poor fruits would not be marketable at retail under usual conditions but could have some salvage value; cull fruits were worthless. This last class included fruits that decayed before ripening. During ripening the relative humidity was maintained near saturation thus minimizing fruit shriveling because of water loss.

RESULTS

Test 1

This test, originated on September 22, compared different amounts of initial ice (Table 1). Car 1-A, pre-iced to full-bunker capacity, represented a usual commercial practice for this time of the year. Car 1-B received half-stage icing in accordance with the experimental schedule. Because of warm weather, both cars were re-iced with 1 ton per bunker about midway enroute.

Pre-icing car 1-A to full-bunker capacity resulted in undesirable low temperatures, below 50° F., in the bottom-bunker position of the load before the initial ice was melted (Figure 1). Re-icing this car with 1 ton of ice in each bunker cooled all parts of the load more than necessary. More desirable temperatures were obtained in Car 1-B. Initially icing this car according to the experimental schedule prevented excessive cooling of the load during the first few days in transit and lessened the danger of chilling temperatures after re-icing in transit.

Fruits in pre-iced car 1-A arrived at the market in a somewhat greener condition than those in half-stage-iced car 1-B. However, there was little ripening of the fruits in either car in transit, as shown in tables 2 and 3. Very few of the fruits in the commercial lots in either car were ripe enough for prepackaging at the first sorting at the market (Table 5).

The total pack-out of marketable fruits from the test packages in both cars after ripening at the market ranged from 87 to 96 percent with the poorest return and longest ripening time in the lot from the bottom-bunker position of car 1-A which was over-refrigerated in transit (Table 4). Better returns with slightly shorter ripening times were obtained in other positions in car 1-A and in all positions in car 1-B, which had higher average transit temperatures. A similar effect of transit temperature on pack-out and ripening time was observed in the commercial lots in these cars (Table 5).

Results of this test show that initial icing according to the experimental schedule provides adequate cooling for early-season shipments. The small amount of fruit ready for prepackaging at the first sorting at the market and the prolonged ripening time indicate that somewhat higher transit temperatures than were obtained in these cars are more desirable.

Test 2

This test was to evaluate re-icing of tomato cars in transit. Two fan cars, 2-A and 2-B, shipped on September 29, were initially iced to half-stage capacity in accord with the experimental schedule. Car 2-A was not re-iced in transit, whereas car 2-B was re-iced at Peoria, Ill. with 1/2 ton in each bunker on the half-stage racks (Table 1).

Both cars maintained temperatures within an acceptable range. Car 2-A warmed slowly after the initial ice was melted, whereas such warm-up was arrested in Car 2-B by the re-icing at Peoria and some cooling resulted (Figure 2).

Fruits in the two cars were in comparable stages of ripeness on arrival at the market and in both no more than 10 percent of the fruits were firm ripe (Tables 2 and 3). Fruits in the commercial loads ripe enough for prepackaging at the first sorting averaged 12 percent in car 2-A and only 8 percent in car 2-B, which was slightly colder in transit.

The total pack-out of marketable fruits from the test packages was much the same in all positions in both cars (Table 4). The same held for the total pack-out of the commercial lots as shown in table 5. However, it is of interest that the total cullage was slightly greater and the time required to ripen the fruits at the market was slightly increased for the cooler car.

In this test, the experimental schedule for initial ice gave the desired amount of cooling. Re-icing the car in transit was not required but it did little or no harm except to delay the ripening of the fruits at the market.

Test 3

This test also involved re-icing in transit and compared non-re-iced car 3-A with re-iced car 3-B (Table 1). Both cars which were shipped on October 6 were initially iced with 1 1/2 tons in each bunker on half-stage racks. The loading temperatures encountered were higher than were expected for this date, and as a result the initial ice of 1 1/2 tons per bunker represented a minimum for car 3-A and was less than the amount suggested by the experimental schedule for car 3-B. This fact is borne out by the relatively warm transit temperatures (Figure 3).

Considerable ripening occurred in transit in both cars. The test packages arrived with 22 to 47 percent of the fruits green and 6 to 15 percent in the firm ripe stage (Table 2). However, there were no soft-ripe fruits and only a negligible amount of decay. The receiver reported that 20 and 36 percent of the fruits in the top layers of cars 3-A and 3-B, respectively, were firm ripe, but there were no soft-ripe or decayed fruits (Table 3).

In the commercial lots, 41 and 44 percent of the fruits in the top layers of the load and 28 and 32 percent in the bottom layers were ripe for prepackaging at the first sorting.

Total pack-outs of marketable fruits from the test and commercial lots as shown in tables 4 and 5 were high for both cars, and the time required for ripening the fruits at the market was reasonably short.

Re-icing of car 3-B was desirable because of the minimum icing at origin . Both cars could have received somewhat more initial ice without danger of overcooling. However, no over-ripeness developed at the relatively high transit temperatures that occurred, and the total pack-out of marketable fruits was very good.

Test 4 and Test 5

The purpose of the tests of cars shipped on October 20 and 26 was to evaluate further the experimental schedule for initial icing. No direct comparisons were involved in these two tests, but car 4 received 1 ton of initial ice per bunker on the bottom racks whereas car 5 received the same amount on half-stage racks. Both cars were re-iced with 1/2 ton in each bunker at Peoria, Ill. (Table 1).

As seen in figure 4, the bottom layer of car 4 cooled somewhat below the desirable temperature range. The fact that the ice was in the bottom of the bunker may have been a contributing factor. More desirable temperatures were obtained in half-stage car 5, as shown in figure 4.

Amount of ripening in transit observed in car 4 is not in agreement with the relatively low temperatures recorded. Even though the transit temperature of the bottom layer appears to be undesirably low, only 27 percent of the fruits in the test packages from this position were green at unloading (Table 2). Fruits in car 5 showed considerable ripening in transit, as shown by the inspection of the test packages and the receiver's report (Tables 2 and 3).

The total pack-out of the test packages from car 4 was the lowest in the test cars (Table 4). Not only was decay rather high, but also the general quality of the ripened fruit was low. The relatively low temperatures in transit and slow ripening of the fruits at the market undoubtedly contributed somewhat to this condition, but it is doubtful that this is the complete explanation. The fruits on arrival at the market were reported as "sound but lacking firmness and life." The pack-out of test packages from car 5 was high (Table 4). No records on the pack-out of commercial lots in either car were obtained.

The transit temperatures in car 4 indicate that an initial icing of 1 ton in each bunker is the maximum desirable for tomatoes loaded at a temperature in the low sixties. This amount of initial ice supplied car 5 loaded with 65° F. fruit resulted in desirable transit temperatures. It is doubtful that re-icing of either car was necessary since the weather in transit was moderately cool.

Test 6

This test consisted of two cars shipped November 10th, to compare a protective service with automatic car heaters and a service not calling for heaters (Table 1). Car 6-A, a fan car, was shipped "Voluntary heater service between Salt Lake City, Utah, and Chicago, Ill. Thermostat set at 50° F." Car 6-B, a non-fan car, was shipped without heater service.

Both cars were initially iced with 1/2 ton in each bunker on half-stage racks approximately according to the experimental schedule. Since low outside temperatures did not occur between Salt Lake City and Chicago, Car 6-A was re-iced with 1/2 ton in each bunker when the heater was removed in order to offset any rise in temperature of the load because of the heater or its pilot light.

As anticipated, the temperature of the load increased more in heater-car 6-A than in non-heater-car 6-B between Salt Lake City and Chicago (Figure 5). Re-icing car 6-A at Chicago with 1/2 ton in each bunker prevented further warming of the load and lowered the temperature somewhat thereafter. Desirable transit temperatures were obtained in car 6-B which was shipped with initial ice only.

On arrival at the market the receiver reported that 15 and 16 percent of the fruits in cars 6-A and 6-B, respectively, were firm ripe, none were soft ripe, and 2 and 1 percent, respectively, were decayed (Table 3). No direct comparison of the condition on arrival of the fruits in the test boxes can be made because car 6-B was unloaded 3 days later than car 6-A. At the time of unloading on the 10th day, car 6-A had very few ripe fruits at any position in the load and none were soft ripe or decayed (Table 2). In car 6-B, unloaded on the 13th day, 21 to 35 percent of the fruits were firm-ripe, 0 to 1 percent soft ripe, and none decayed.

The pack-out of marketable fruits was high in the test lots of both cars. However, the percentage of fruits classified as "good" was somewhat lower in this test than in earlier tests in which the transit temperatures were similar (Table 4). No records on the pack-out of the commercial loads were obtainable.

As it is doubtful that the heater functioned, except for its pilot light, during the mild weather, the test shows the effect the pilot light of an automatic heater has on the temperature of the load and that this effect can be offset by a light re-icing of the car after removal of the heater.

California Holding Tests

Quality of the fruits ripened in the holding tests is shown in Table 6. Since the results of the September 23 harvest were essentially the same as those of the October 1 harvest, they have been omitted from the table. The effect of a simulated-transit period at various temperatures in relation to date of harvest is illustrated by these results.

Sample lots held at 41° F. for the 10-day simulated-transit period showed a lower percentage of good-quality fruits upon ripening than did those samples held at temperatures above 50°. Fruit at a simulated-transit temperature of 41° was inferior to that at 50° except for the harvests of October 12 and November 9. Despite the lowered quality of the ripe fruits following exposure to 41°, the percentage of fruits classified as marketable (good plus fair) remained at approximately 90 percent until the harvest of November 3. The harmful effect of the 41° exposure was especially striking for the harvests of November 3 and 16.

The 10-day exposure to 50° F. tended to be somewhat harmful as compared with exposure to higher temperatures, but this tendency did not hold in all comparisons. Simulated transit at 55°, 62°, or 68° temperatures had comparable effects on quality except for the harvests of November 3 and 16 in which 55° treatment was inferior to the higher temperatures.

In general, the highest percentage of good fruits and of total marketable fruits resulted from simulated-transit temperatures of 55°, 62°, or 68° F. This finding is in agreement with the 1952 results.

Even when the fruits were placed directly at a desirable ripening temperature of 68° F., a reduction in the percentage of good fruits was observed for the harvest of October 12 and later. However, only for the last harvest (November 16) was ripening especially poor. The maximum and minimum temperatures recorded in a field near Carbona and in one near Tracy (Rhodes) are shown in figure 6. The total number of hours below 50° to each of the harvest dates is given in table 6. These values together with the minimum and maximum temperatures give a general picture of the temperature to which the fruits were exposed in the field.

When the data of several seasons were considered, it was found that the number of hours below 60° F. during the week prior to harvest was of more value as an index to the expected ripening of the fruits than the total seasonal hours below 50° as previously suggested. When there are less than 95 hours below 60° there is little or no harm from field chilling but when there are 95 to 115 hours, some reduction in marketable fruits can be expected. Further increase to 115 to 135 hours usually results in a serious reduction of ripening room pack-out, and when the number of hours below 60° exceeds 135 it is doubtful that harvesting and packing are justified. This relationship is shown by the 1953 data (Table 6).

The 1953 results confirm earlier findings that prolonged cool weather just before harvest may reduce the percentage of marketable fruits and that chilling during transit should be avoided. Very late in the season the percentage of marketable fruits may be reduced even though they receive no additional chilling after harvest. Both the field temperatures and the subsequent ripening behavior indicate that the 1953 fall season was favorable for the production of tomatoes capable of ripening satisfactorily at all harvests made through November 9.

In the holding tests it also was possible to observe the rate of ripening of the fruits during simulated-transit periods at various constant temperatures. The fruits were classified as to ripeness at the end of the 10-day simulated-transit period. The average range in percentages of fruit of different stages of ripeness that occurred after 10 days for the nine harvests are shown in table 7. As was expected, the ripening rate increased with temperature. The amount of ripening that occurred in these holding tests at constant temperatures was greater than that occurring in the shipping tests at comparable average transit temperatures (Table 8). However, the results indicate that temperatures up to 68° F. do not result in over-ripeness within a 10-day period. The wide variation in rate of ripening was probably due to differences in average maturity at time of harvest.

Table 1. - Loading information and protective services for tomatoes in test cars shipped with vents closed from California to New York City via Ogden, or Salt Lake City, Utah, fall 1955.

Test car 1/	Date shipped	Shipping point	Fruit temperature at loading °F	Initial icing at shipping point	Re-icing in transit
1-A	Sept. 22	Brentwood, Calif.	71	Full bunker capacity 2/	1 ton in each bunker at Peoria, Ill.
1-B	" "	" "	73	Half-stage capacity	1 ton in each bunker at Kansas City, Mo.
2-A	Sept. 29	" "	70	Half-stage capacity	None
2-B	" "	" "	72	Half-stage capacity	1/2 ton in each bunker at Peoria, Ill.
3-A	Oct. 6	" "	74	1 1/2 tons in each bunker, on half-stage racks	None
3-B	" "	" "	77	1 1/2 tons in each bunker, on half-stage racks	1/2 ton in each bunker at Peoria, Ill.
4	Oct. 20	Stockton, Calif.	62	1 ton in each bunker, on bottom racks	1/2 ton in each bunker at Peoria, Ill.
5	Oct. 26	Brentwood, Calif.	65	1 ton in each bunker, on half-stage racks	1/2 ton in each bunker at Peoria, Ill.
6-A	Nov. 10	Rhodes, Calif.	62	1/2 ton in each bunker, on half-stage racks 3/	1/2 ton in each bunker at Chicago, Ill.
6-B	" "	" "	60	1/2 ton in each bunker, on half-stage racks	None

1/ Fan cars, except car 6-B.
2/ Pre-iced car, not replenished.
3/ Voluntary heater service (rule 580) from Salt Lake City, Utah, to Chicago, Ill.

Table 2. - Arrival condition of fruits in test boxes.

Test car 1/	Date shipped	Position in car	Average transit temperature	Time in car	Fruits in indicated condition 2/				
					Green	Turning	Firm Ripe	Soft Ripe	Decayed
			°F	Days	Pct.	Pct.	Pct.	Pct.	Pct.
1-A..	Sept. 22	TD	56	9	75	24	1	0	0
		MQ	59	9	62	37	1	0	0
		BB	48	9	76	24	0	0	0
1-B..		TD	63	9	59	36	5	0	0
		MQ	66	9	40	51	8	0	1
		BB	58	9	78	22	0	0	0
2-A..	Sept. 29	TD	63	9	55	41	3	0	1
		MQ	65	9	48	44	7	0	1
		BB	57	9	69	31	0	0	0
2-B..		TD	61	10	53	40	7	0	0
		MQ	64	10	42	49	9	0	0
		BB	55	10	71	28	0	0	1
3-A..	Oct. 6	TD	68	9	25	69	6	0	0
		MQ	71	9	22	70	8	0	0
		BB	65	9	38	55	6	0	1
3-B..		TD	68	9	25	64	11	0	0
		MQ	68	9	23	60	15	0	2
		BB	62	9	47	47	6	0	0
4 ...	Oct. 20	TD	53	9	47	49	4	0	0
		MQ	57	9	37	60	3	0	0
		BB	51	9	27	70	1	0	2
5 ...	Oct. 26	TD	59	11	17	76	7	0	0
		MQ	59	11	17	72	11	0	0
		BB	57	11	24	72	3	0	1
6-A..	Nov. 10	TD	63	10	31	62	7	0	0
		MQ	63	10	28	65	7	0	0
		BB	60	10	46	50	4	0	0
6-B..		TD	62	13	8	62	29	1	0
		MQ	62	13	8	56	35	1	0
		BB	59	13	19	60	21	0	0

1/ See table 1 for protective services.
2/ Each lot consisted of 2 packed boxes from the top doorway (TD), middle quarter (MQ), or bottom bunker (BB) position in the car.

Table 3. - Arrival condition of commercial loads in test cars as indicated by receiver's "top-layer" inspection.

Test car 1/	Date shipped	Average transit temperature	Time in car	Fruits in indicated condition 2/				
				Green	Turning	Firm Ripe	Soft Ripe	Decayed
		°F	Days	Pct.	Pct.	Pct.	Pct.	Pct.
1-A...	Sept. 22	56	8	89	10	1	0	0
1-B...		63	8	71	20	9	0	0
2-A...	Sept. 29	63	8	68	22	10	0	0
2-B...		61	9	77	12	10	0	1
3-A...	Oct. 6	68	9	35	45	20	0	0
3-B...		68	9	28	36	36	0	0
4	Oct. 20	53	9	46	10	44	0	0
5	Oct. 26	59	9	25	36	39	0	0
6-A...	Nov. 10	63	8	17	66	15	0	2
6-B...		62	9	19	64	16	0	1

1/ See table 1 for protective services.
2/ Number of packages inspected not reported.

Table 4. - Market quality of fruits from test boxes after ripening at 65° F.

Test car	Date shipped	Position in car	Average transit temperature	Ripening time at 65° 1/	Fruits of indicated quality 2/				Fruits marketable 3/
					Good	Fair	Poor	Decayed	
			°F	Days	Pct.	Pct.	Pct.	Pct.	Pct.
1-A	Sept. 22	TD	56	15	80	15	4	1	95
		MQ	59	14	71	21	6	2	91
		BB	48	16	60	27	10	3	87
1-B		TD	63	14	77	19	4	0	96
		MQ	66	12	73	22	4	1	95
		BB	58	14	73	21	5	1	94
2-A	Sept. 29	TD	63	13	75	19	5	1	94
		MQ	65	11	73	20	6	1	93
		BB	57	15	74	17	8	1	91
2-B		TD	61	13	77	18	4	1	95
		MQ	64	13	78	17	4	1	95
		BB	55	15	74	19	4	3	93
3-A	Oct. 6	TD	68	9	83	12	4	1	95
		MQ	71	8	78	18	4	0	96
		BB	65	10	86	9	4	1	95
3-B		TD	68	8	80	15	4	1	95
		MQ	68	8	75	17	6	2	92
		BB	62	10	79	17	3	1	96
4	Oct. 20	TD	53	14	49	28	16	7	77
		MQ	57	14	52	20	10	18	72
		BB	51	14	42	26	15	17	68
5	Oct. 26	TD	59	9	84	12	2	2	96
		MQ	59	9	75	17	6	2	92
		BB	57	11	75	15	6	4	90
6-A	Nov. 10	TD	63	9	71	22	6	1	93
		MQ	63	9	64	26	8	2	90
		BB	60	10	63	30	6	1	93
6-B		TD	62	6	69	21	8	2	90
		MQ	62	6	63	25	9	3	88
		BB	59	10	65	25	7	3	90

1/ Approximate time for 90 percent of the fruits to ripen.
2/ Each lot consisted of 2 packed boxes from the top doorway (TD), middle quarter (MQ), or bottom bunker (BB).
3/ Only good and fair fruits considered marketable.

Table 5. - Market pack-out of commercial lots from tests 1, 2, and 3 1/

Test car	Date shipped	Position in car	Average transit temperature	Date of first sorting	Fruits at first sorting: Ripe for prepackaging	Fruits at first sorting: Culled	Fruits in all sortings: Ripe for prepackaging	Fruits in all sortings: Culled	Time between first and final sortings
			°F		Pct.	Pct.	Pct.	Pct.	Days
1-A	Sept. 22	TD	56	Oct. 1	3	1	92	8	14
		BB	48		2	1	91	9	15
1-B		TD	63	Oct. 1	11	1	96	4	12
		BB	58		8	1	93	7	13
2-A	Sept. 29	TD	63	Oct. 8	16	2	93	7	11
		BB	57		8	2	92	8	14
2-B		TD	61	Oct. 9	8	1	91	9	14
		BB	55		8	2	89	11	15
3-A	Oct. 6	TD	68	Oct. 16	44	2	95	5	8
		BB	65		32	1	94	6	9
3-B		TD	68	Oct. 16	41	2	94	6	7
		BB	62		28	2	94	6	9

1/ Each lot consisted of 25 packed boxes from either the top-doorway (TD) or the bottom bunker (BB) position of the load. All percentages based upon the original number of fruits shipped.

Table 6. - Market quality of fruits in holding tests as affected by date of harvest and simulated transit conditions.

Date of harvest	Total time below 50°F. in field	Time below 60°F. week preceding harvest	Temperature during 10 days of simulated transit	Fruits of indicated quality when ripe 1/				Fruits marketable 3/
				Good	Fair	Poor	Cull 2/	
	Hrs.	Hrs.	°F.	Pct.	Pct.	Pct.	Pct.	Pct.
Oct. 1-	26	61	68	94	5	0	1	99
			62	95	1	0	4	96
			55	92	7	0	1	99
			50	91	7	0	2	98
			41	81	9	1	9	90
Oct. 6-	36	69	68	93	7	0	0	100
			62	77	18	4	1	95
			55	85	11	1	3	96
			50	87	4	0	9	91
			41	70	20	5	5	90
Oct. 12-	49	68	68	77	18	1	4	95
			62	80	16	3	1	96
			55	81	13	4	2	94
			50	65	26	3	6	91
			41	74	17	4	5	91
Oct. 20-	91	89	68	75	22	2	1	97
			62	83	12	3	2	95
			55	75	15	5	5	90
			50	73	20	2	5	93
			41	64	24	4	8	88
Oct. 27-	145	104	68	86	11	2	1	97
			62	92	3	1	4	95
			55	89	8	2	1	97
			50	79	15	2	4	94
			41	73	18	3	6	91
Nov. 3-	195	95	68	81	14	5	0	95
			62	77	20	3	0	97
			55	62	26	6	6	88
			50	62	28	5	5	90
			41	34	27	25	14	61
Nov. 9-	267	110	68	72	14	7	7	86
			62	79	18	3	0	97
			55	71	14	4	11	85
			50	60	34	4	2	94
			41	70	17	6	7	87
Nov. 16-	301	116	68	17	38	30	15	55
			62	8	37	46	9	45
			55	5	25	39	31	30
			50	1	25	43	31	26
			41	0	3	26	71	3

1/ Tomatoes harvested in Tracy district and ripened at Davis, Calif. One commercially packed box of 6 x 6 size (108 fruits) held at each temperature for 10 days of simulated transit before unpacking and ripening at 68° F.

2/ All decayed fruits included with culls.

3/ Only fruits classed as good or fair were considered marketable.

Table 7. - Ripening of fruits in holding tests as affected by 10 days of simulated transit at constant temperatures.

Temperature of simulated transit	Fruits in indicated condition 1/					
	Green		Turning		Firm ripe	
	Range	Average	Range	Average	Range	Average
°F.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.
68	0 to 56	13	13 to 52	32	11 to 86	55
62	0 to 77	20	15 to 56	35	3 to 85	45
55	4 to 78	26	19 to 91	60	2 to 46	14
50	10 to 93	44	7 to 74	53	0 to 18	3
41	26 to 96	59	4 to 74	41	--	0

1/ Nine commercially packed boxes representing approximately weekly harvests from Sept. 23 to Nov. 16, 1953, were held at each of the indicated temperatures.

Table 8. - Ripening of fruits in shipping tests during 9 to 11 days in transit as influenced by average temperature.

Average transit temperature	Fruits in indicated condition at unloading					Fruit lots inspected
	Green	Turning	Firm ripe	Soft ripe	Decayed	
°F.	Pct.	Pct.	Pct.	Pct.	Pct.	No.
Between 66 and 71	27	63	9	0	0.6	5
Between 61 and 65	45	49	6	0	0.3	9
Between 56 and 60	47	49	4	0	0.0	9
Between 48 and 55	55	43	1	0	0.8	4

Figure 1. Transit temperatures and estimated ice supply in two fan cars shipped with vents closed from Brentwood, California to New York City, September 22, 1953. Test 1

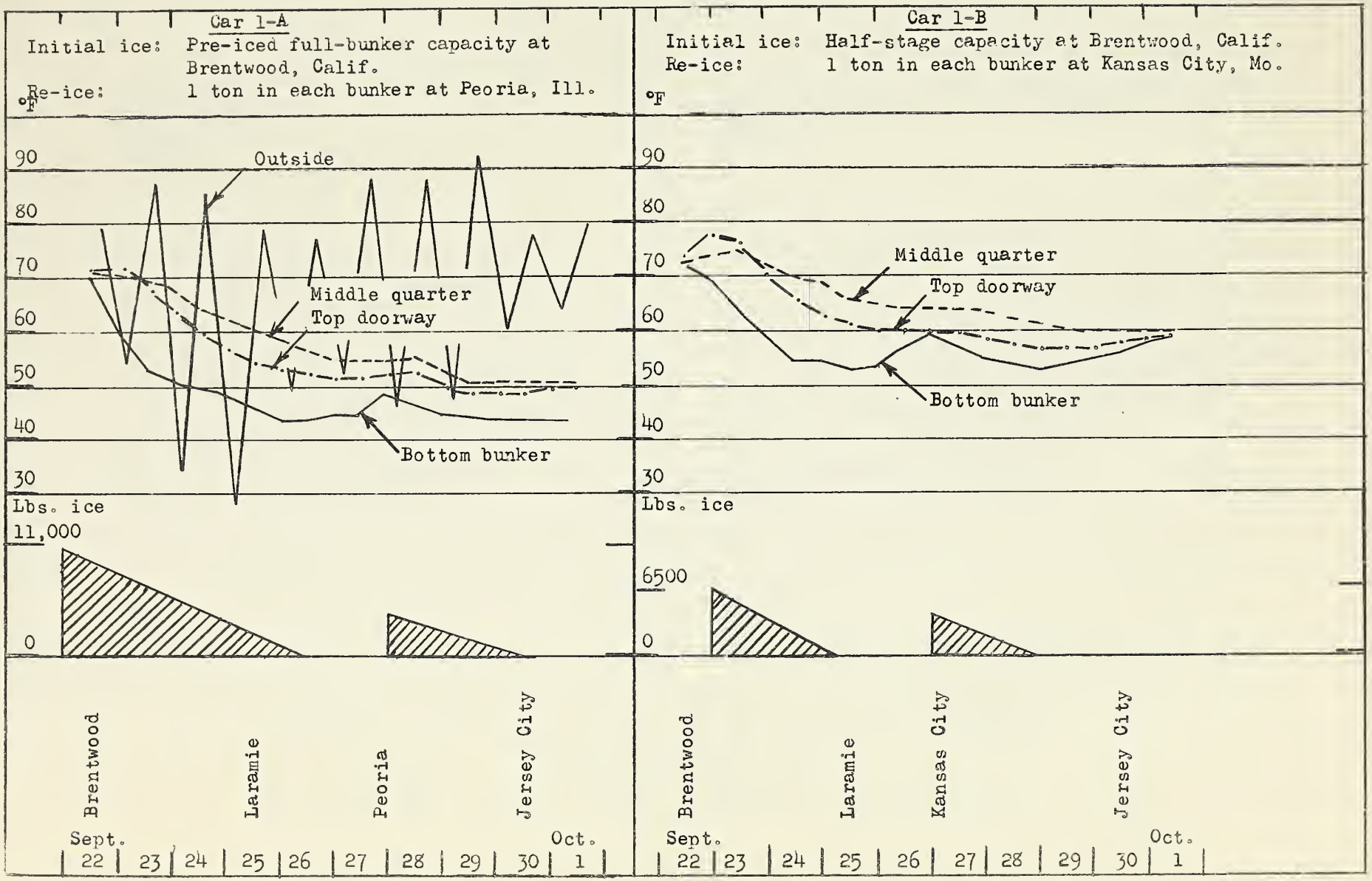


Figure 2. Transit temperatures and estimated ice supply in two fan cars shipped with vents closed from Brentwood, California to New York City, September 29, 1953. Test 2

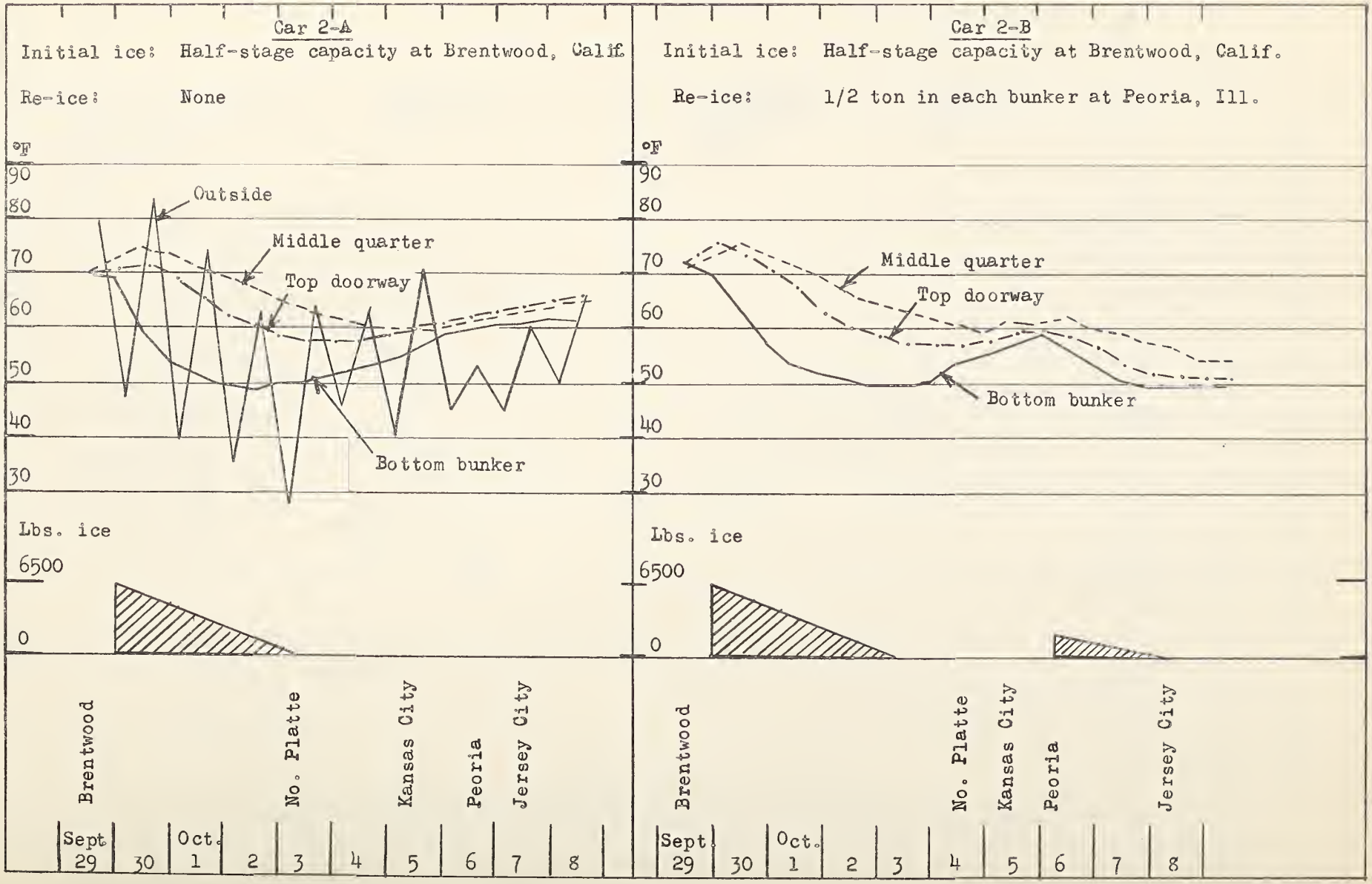


Figure 3. Transit temperatures and estimated ice supply in two fan cars shipped with vents closed from Brentwood, California to New York City, October 6, 1953. Test 3

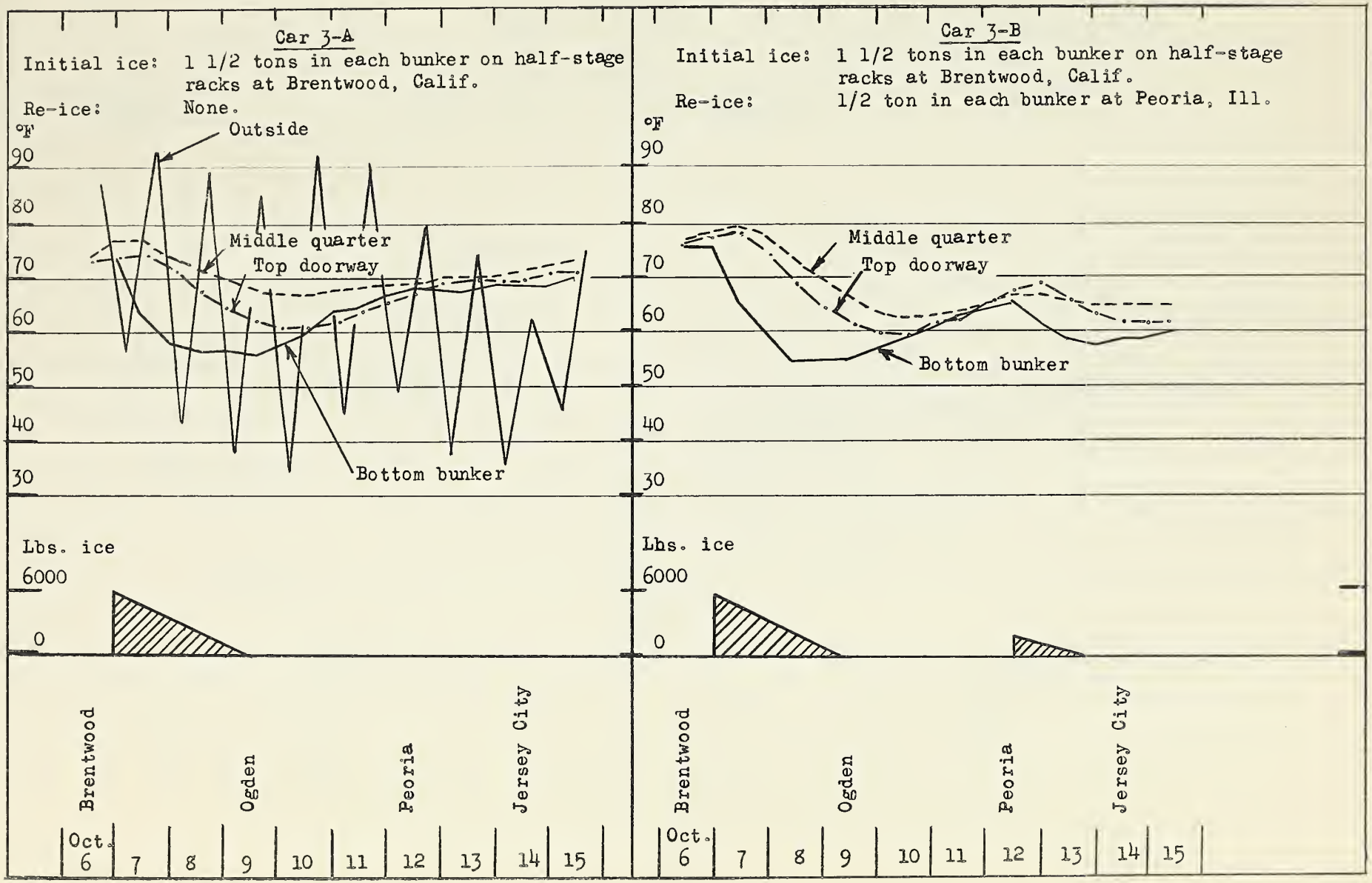


Figure 4. Transit temperatures and estimated ice supply in two fan cars shipped with vents closed to New York City; Car 4 from Stockton, California, October 20, and Car 5 from Brentwood, California, October 26, 1953. Tests 4 and 5.

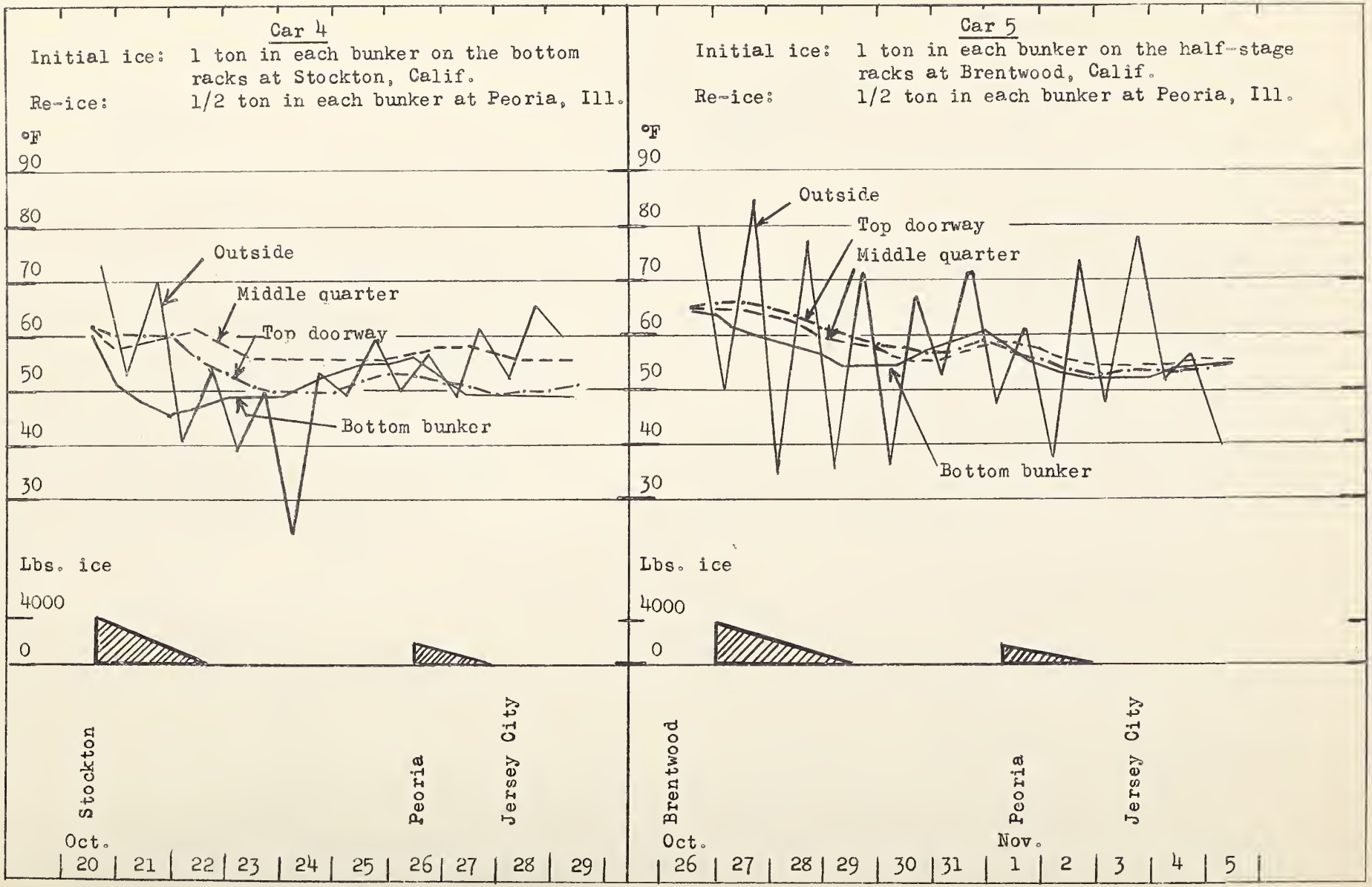


Figure 5. Transit temperatures and estimated ice supply in two cars shipped with vents closed from Rhodes, California to New York City, November 10, 1953. Test 6

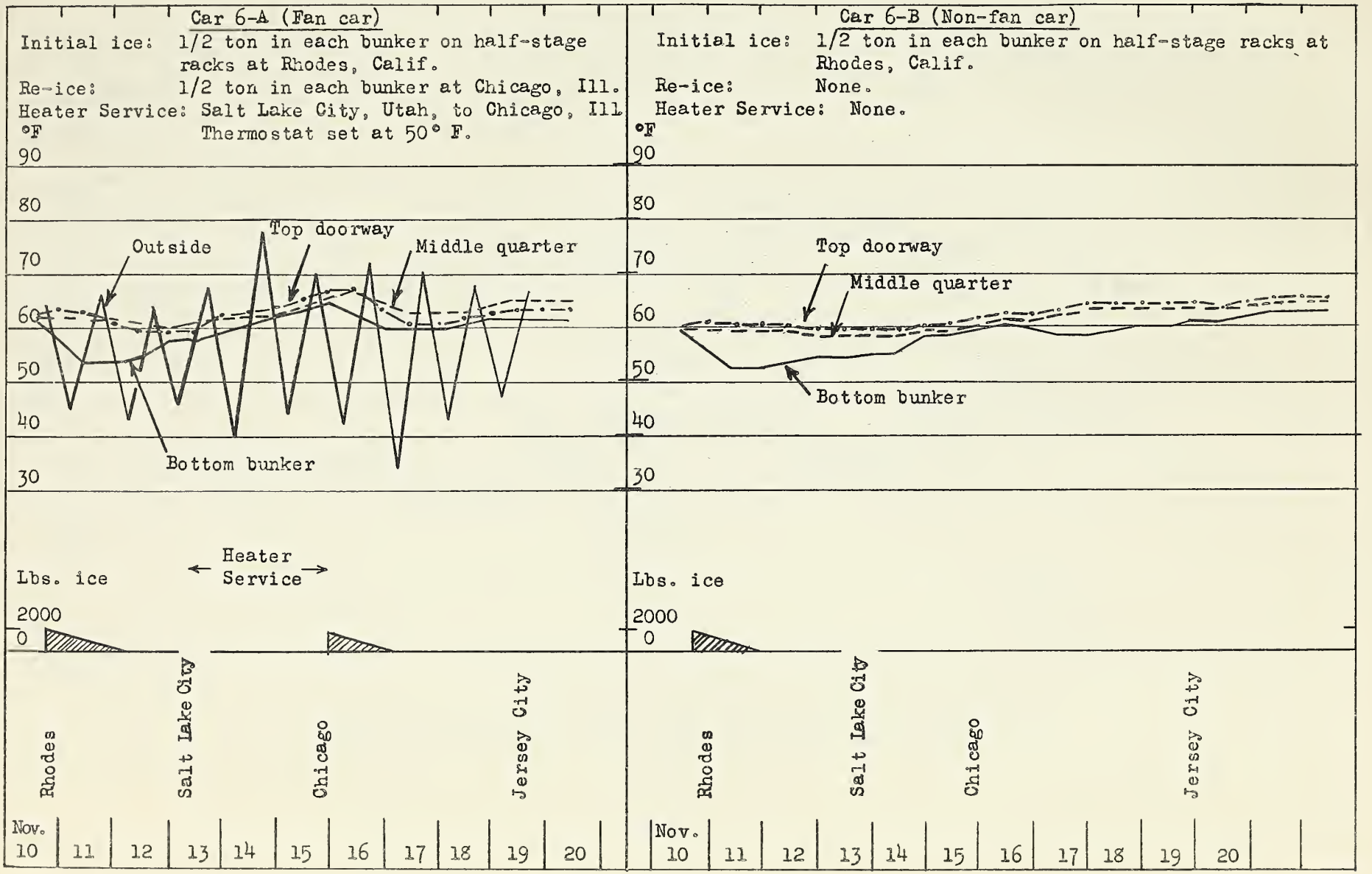
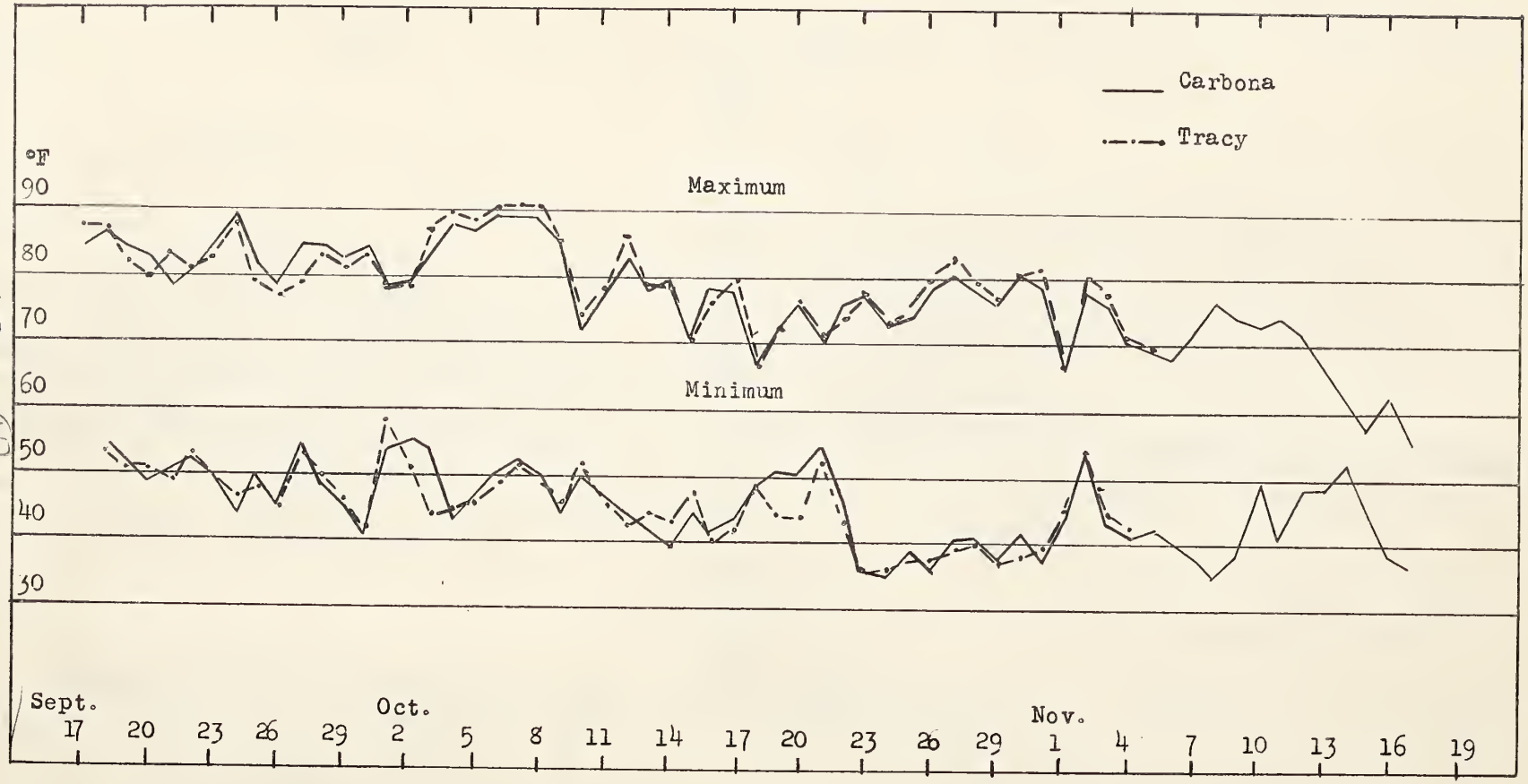


Figure 6

Maximum and minimum air temperatures 10 inches above ground level in tomato fields near Carbona and Tracy, California,--Fall 1953.